

High-Frequency Ultrasound in the Evaluation of Psoriatic Arthritis: A Clinical Study

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Abstract: *Background:* This study aimed to compare high-frequency ultrasound (HFU) findings in the fingers with psoriatic arthritis (PsA) and rheumatoid arthritis (RA) and to explore the potential use of HFU in the early diagnosis of PsA. *Methods:* Forty-four PsA patients with 123 fingers with symptoms, 39 RA patients with 122 fingers with symptoms and 20 healthy patients were recruited as controls. The ultrasound imaging manifestation and blood flow of fingers were recorded and compared. The results were analyzed by the χ^2 test. *Results:* Abnormal ultrasound findings in the fingers of RA and PsA patients were identified and compared. Among RA patients, 82 (67.21%) were diagnosed with joint effusion, 78 (63.93%) were synovial thickening and 59 (48.36%) were bone erosion, while no tenosynovitis, soft tissue inflammation or enthesitis was found. However, among the patients with PsA, 75 (60.97%) were diagnosed with joint effusion, 68 (55.28%) were synovial thickening, 71 (57.72%) were bone erosion, 71 (57.72%) were tenosynovitis, 44 (35.77%) were soft tissue inflammation and 39 (31.70%) were enthesitis. *Conclusions:* HFU proved valuable in detecting soft tissue inflammation and enthesitis in the fingers of PsA patients. HFU may be an easy, safe and effective examination in the early diagnosis of PsA and observation of pathological changes of PsA.

Key Indexing Terms: High-frequency ultrasound; Psoriatic arthritis; Rheumatoid arthritis; Ultrasound imaging. [Am J Med Sci 2015;350(1):42-46.]

Psoriatic arthritis (PsA) is defined as a unique inflammatory arthritis associated with psoriasis. It constitutes of 7% to 36% of psoriatic patients in different samples and up to 1% of the global population.¹ PsA is proved to be more complicated with a different driver of disease processes compared with rheumatoid arthritis (RA).² A variable spectrum of pathologic condition, such as joint and tendon inflammation, enthesitis, new bone formation, severe osteolysis and overlap of all of these, can be found in PsA patients.³ The finger is one of the most frequent disease sites in PsA and ankylosis, and even, deformity could be developed in 50% of the late-stage PsA patients.⁴ Currently, there are no specific markers that can accurately predict disease progression and therapeutic response and "gold standard" is still lacking.⁵ However, the main entheses of the lower limb around the calcaneum is the hallmark features of enthesitis in PsA and form part of the newly developed CASPAR (ClASsification for Psoriatic ARthritis) criteria for PsA.⁶ Enthesitis, which is an anatomic location where tendon, ligament or capsule attaches to bone, has been proposed as a significant domain of assessment and outcome in PsA.⁶

The continuous technological advances in the field of ultrasound have allowed the development of equipment

provided with high variable frequency probes and very sensitive power Doppler. With the advantages of higher sensitivity, high-frequency ultrasound (HFU) (>10 MHz) is increasingly being used in evaluating soft tissue involvement both in early inflammatory arthritis and in late disease^{7,8} compared with clinical evaluation and x-rays.⁹ Power Doppler sonography affords visualization of small vessel flow, showing soft tissue inflammation and disease activity in peripheral arthritis.^{10,11} Fournie et al¹² reported that inflammation of the fibrous skeleton of the finger might lead to the radiological and clinical features that could distinguish PsA from RA of the finger. However, few reports have investigated the ability of HFU in PsA evaluation in China.

Here, the authors presented a study on the comparison of the ultrasound features found by HFU and counted the patients number with different symptoms to explore the application potential in PsA diagnosis.

PATIENTS AND METHODS

Patients

Forty-four PsA patients with 133 involved fingers, 39 RA patients with 132 involved fingers and 20 healthy patients were recruited who attended the Department of Rheumatology in the hospital from October 2010 to June 2013. The PsA patients were diagnosed according to the CASPAR criteria.¹³ The involved RA patients were diagnosed according to the classification criteria of American College of Rheumatology/European League Against Rheumatism issued in 2010.¹⁴ The exclusion criteria of patients were as follows: (1) diagnosed with other inflammatory joint disease, such as osteoarthritis, gout, etc; (2) with a history of hand trauma surgery or severe hand joint deformity, current engagement in heavy manual work and (3) with hand psoriasis, rash or nail lesion. In addition, no local infection or trauma was found in any of the patients. The whole protocol was approved by Ethics Committee of the hospital, and written informed consent was provided by all patients before enrollment.

Ultrasound and Power Doppler Examination

The ultrasound examination of the patients' finger was performed by 2 rheumatologists who had experienced in musculoskeletal ultrasound and were blinded to the patients' clinical and x-ray data. The 2 rheumatologists agreed on the examination and evaluation system before the ultrasound examination. All joints and tendons of fingers were examined using a commercially available color-Doppler ultrasound machine (MyLab 30 CV; ESAOTE SpA, Genoa, Italy) equipped with a multifrequency linear transducer (18 MHz). Low-speed blood flow and highest gain without signal noise was adjusted when performing the Power Doppler sonography. Bilateral controlled examinations were performed on each finger to grasp the pathological features in the PsA or RA patients.

The patients were in optimal seated posture with the forearm in extension over the table, and a pillow was placed under their arms. The patients slightly extended the waist with

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upturned palms when the palmar surface was scanned. In addition, the patients were slightly bent at the waist with palm downturned when the dorsum of hand was scanned. Direct contact scan was performed in most of the subjects, and indirect scan was performed for those patients with low amount of subcutaneous fat on parts of limbs and for facet joints with rough skin. The examinations included extensor tendon, flexor digitorum tendon, subcutaneous soft tissue and all the joints (metacarpophalangeal [MCP], proximal and distal interphalangeal [PIP and DIP]). Bilateral controlled examinations on palm, dorsum and lateral side by vertical or horizontal scan were performed in all fingers according to previous description.¹⁵ The presence of dactylitis was recorded if sausage digit was observed. The symptoms, such as joint effusion, synovitis, bone erosion, tenosynovitis, soft tissue inflammation and enthesitis, were observed by 2-dimensional ultrasound. Color Doppler flow imaging and color Doppler energy were performed to observe blood flow distribution of joint and synovitis and peritendineum or soft tissue inflammatory.

Statistical Analysis

Statistics were carried out using SPSS 13.0 software (SPSS Inc, Chicago, IL). Counted data were present with percentage. Pairwise comparisons between groups were carried out using the χ^2 test. $P < 0.05$ was considered as statistically significant.

RESULTS

Patient Data

As shown in Table 1, the age of the patients in PsA, RA and healthy control group was 44.6 ± 10.1 (18–65) years, 46.2 ± 12.2 (18–65) years and 43.6 ± 12.5 (18–65) years, respectively. No significant difference was found among 3 groups. No significant difference was found between PsA and RA group on female/male ratio. The disease course in PsA and RA group was 3 months to 7 years and 3 months to 5 years, respectively.

Clinical Manifestation of the Patients

A total of 123 fingers with the presence of symptoms were identified in the 44 patients with PsA, including 25 sausage-like fingers and 98 fingers with swelling or pain. Among these swollen or painful fingers, 91 were single joint (swelling or pain) and 7 were with 2 symptomatic joints. The involved joints could be further divided into 39 MCP, 34 PIP and 32 DIP. However, in RA group, 122 involved fingers were found in 39 patients. Of them, 90 were single joint (swelling or pain) and 32 were with 2 symptomatic joints. Besides, among the involved joints, 82 were MCP and 72 were PIP. No swollen or painful fingers were found in the healthy control group (Table 2).

Ultrasound Manifestation of the Patients

As shown in Table 3, 44 patients in PsA and 39 patients in RA group were presented with ultrasound abnormalities.

Joint Effusion

Seventy-five fingers in PsA group were found with joint effusion. The ultrasound showed compressible echo-free zone in joint lumen and the positive rate was 60.97%. Eighty-two involved fingers in RA group were found with joint effusion and the positive rate was 67.21%. No significant difference was found on the positive rate of joint effusion between RA group and PsA group ($P > 0.05$). Four joints (4 patients) were presented with pain but not swelling, and joint effusion was found by ultrasound. Two patients were presented with joint swelling at 1-month follow-up.

Synovial Thickening

In PsA group, 68 fingers of the patients were found with synovial thickening (Figure 1). The ultrasound showed an incompressible low echo zone in joint lumen and the positive rate was 55.28%. In RA group, 78 fingers were found with synovial thickening. No significant difference was found on synovial thickening between these 2 groups ($P > 0.05$). Among them, 11 of synovial thickening were found with dot, rod, strip-like blood signal under display mode of color Doppler energy or Color Doppler flow imaging.

Bone Erosion

In PsA group, 71 fingers of the patients were found with bone erosion. Destruction of the bone surface was found near the joint, discontinuous bone surface was found at same site of 2 vertical planes and the positive rate was 57.72%. In RA group, 59 fingers were found with bone erosion. No significant difference was found on bone erosion between the 2 groups ($P > 0.05$). Among them, 11 fingers in PsA and 14 fingers in RA group were presented with bone destruction at the same position by x-ray.

Tenosynovitis

In PsA group, 71 fingers of the patients were found with tenosynovitis (Figure 2). The ultrasound showed a compressible echo-free zone at peritendon and the positive rate was 69.91%. In RA group, no tenosynovitis was found. Significant difference was found on tenosynovitis between the 2 groups ($P < 0.01$). Among them, 25 fingers with sausage-like manifestation were found with tenosynovitis.

Soft Tissue Inflammation and Enthesitis

In PsA group, 83 fingers were found with soft tissue inflammation and enthesitis. Among them, 21 fingers were diagnosed with periosteal reaction and a high echo line paralleled to bone surface was found around the joint. Furthermore, 18 fingers were found with teno-osteophyma and a needle-like high-density shadow was found at tendon insertion sites. In addition, 44 fingers of the patients were found with soft tissue inflammation and the whole finger was presented with soft tissue thickening and intensified blood flow signal. In RA group, no soft tissue inflammation or enthesitis was found. Significant difference was found on soft tissue

TABLE 1. Patient demographic data

Group	PsA (n = 44)	RA (n = 39)	Healthy control (n = 20)
Age, yr (mean \pm SD, range)	44.6 \pm 10.1 (18–65)	46.2 \pm 12.2 (18–65)	43.6 \pm 12.5 (18–65)
Gender, n (F/M)	18/26	26/13	9/11
Disease course	3 mo to 7 yr	3 mo to 5 yr	–

PsA, psoriatic arthritis; RA, rheumatoid arthritis.

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